ECONOMY AND ENVIRONMENT PROGRAM FOR SOUTHEAST ASIA

Overfishing in the Philippine Marine Fisheries Sector

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Danilo C. Israel*
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January, 1998

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OVERFISHING IN THE PHILIPPINE MARINE FISHERIES SECTOR

Danilo C. Israel and Cesar P. Banzon

1. Introduction

The fisheries sector of the Philippines is a significant contributor to its economy. The total output of the sector comprises approximately five percent of the Gross National Product. Furthermore, fisheries production meets more than two-thirds of the national animal protein consumption (Guerrero 1989; BAR 1991).

While it is economically significant, the fisheries sector currently faces a serious problem that threatens its viability as economic base—overfishing (Silvestre and Pauly 1987; Dalzell et al. 1987; Trinidad et al. 1993; Padilla and De Guzman 1994). It has been argued that if the current rate of overfishing continues unabated, marine fisheries may collapse as important edible fish species virtually become extinct.

A survey of the available literature, however, shows gaps in the research on overfishing which must be addressed. Among others, an important limitation of past studies is that analyses were mainly based on groupings of species (small pelagic and demersal species). This approach may render results inadequate for actual fisheries management and policy-making which may be sector-based.

The objective of this paper is to address this research gap by looking into the issue of overfishing using a sectoral approach (i.e., in terms of commercial fisheries, municipal fisheries and total marine fisheries). It is hoped that the results will help show whether or not overfishing indeed exists as sectoral problem.

This paper also attempts to provide, given limited data, some preliminary estimation of the likely employment impacts that may result from future reductions in fishing effort intended to control overfishing. This exercise is aimed to provide a rough picture of the social cost, albeit partial, of possible effort reduction within the marine fisheries.

A review of the performance of fisheries and its different subsectors is presented in Section 2. Section 3 summarizes the overfishing problem in the marine fisheries using species-based data obtained from past studies. The basic theory and models of overfishing are discussed in Section 4 while Section 5 explains the data used in the study. Finally, Section 6 presents the results of the study while Section 7 provides the conclusions and recommendations.

2.0 PERFORMANCE OF THE FISHERIES SECTOR

In terms of output, the fisheries sector has grown steadily in recent years (Table 1). From 1981 to 1994, the sector posted an average annual growth rate of 3.30 percent, in terms of quantity, and 14.84 percent, in terms of value of production. Among the four fisheries sub-sectors, aquaculture and commercial fisheries grew the fastest, in quantity terms. Municipal marine fisheries and inland fisheries increased the slowest.

The fisheries industry employs about one million fishermen and fish farmers, highlighting its importance as a generator of mainly rural jobs (BFAR 1991). Of these, 36 percent were in municipal marine fisheries, 29 percent were in commercial fisheries, 27 percent were in aquaculture and 8 percent were in inland fisheries (Figure 1). Thus, within the fisheries sector, the municipal marine and commercial fisheries are the most important sub-sectors in terms of employment.

In addition, when all backward and forward linkages are considered, about 12 percent of the general population of the country were in one way or another dependent on fisheries-related activities for their livelihood (Trinidad et al. 1993). This highlights the importance to the national economy of fisheries as employment base. It is not known how much of these employment linkages can be attributed specifically to the municipal marine and commercial fisheries but these shares are expected to be substantial.

The fisheries industry has been a steady dollar earner also. In recent years, fishery exports have been growing at very high rates annually, especially in value terms (Table 2). While this was the case, however, imports have increased as well, at even greater rates than exports. Because of this, the industry has been recording negative net exports recently, in quantity terms, although in value terms, it has been posting positive net exports.

3.0 OVERFISHING IN THE MARINE FISHERIES

Based on species-based studies, the overfishing problem in the marine fisheries can be summarized as follows (Table 3). Over time, the catch per unit effort (CPUE) for both small pelagic and demersal species has steadily fallen. By 1984, it was only approximately a third of the 1965 figure. In contrast, fishing effort rose in 1984 to greater than five times the 1965 level. Clearly, while more and more effort has been dedicated to catching fish, the yield per unit has been fast declining also.

A graphical presentation of the overfishing data, however, indicates that there were years when fishing effort actually declined instead of increased (Figure 2). For small pelagic species, fishing effort decreased in the late 60s, early 70s, mid-70s and mid-80s. For the demersal species, on the other hand, effort fell in the middle and late 70s. While this was so, there is no mistaking that the overall general trend of fishing effort has been increasing over the whole period.

A similar case can be observed about the CPUE (Figure 3). For small pelagic species, it increased in the early and late 70s while for demersal species, it rose in the late 60s and mid-70s. However, the overall trend of the CPUE has been falling over the whole period.

4.0 THE THEORY AND MODELS OF OVERFISHING

4.1 Basic Theory

In general, overfishing can be classified into four categories (Pauly 1987). One is growth overfishing which occurs when fish are caught even before they have a chance to grow. Another is recruitment overfishing which happens when the adult fish population is caught in large numbers so that reproduction is impaired. The third is ecosystem overfishing which takes place when the decline in a once abundant fish stock due to fishing is not compensated for by an increase in the stock of other species. The fourth category is economic overfishing which occurs when increases in the fishing effort lead to profit levels that are below the desired maximum.

Of these overfishing categories, economic overfishing may be of the most interest to fisheries managers and planners because fisheries resources are primarily viewed as economic resources (i.e., generators of food and employment). As such, any disruption in fisheries will be analyzed eventually in terms of how much it impacts on its role as an economic sector.

The basic theory behind marine overfishing is well discussed in the literature (e.g., Cunningham et al. 1985; Panayotou and Jetanavanich 1987; Schatz 1991). Thus, here, only a summary is presented. In brief, the theory starts with the notion of the sea as a fishery resource owned by no one and whose exploitation is open to everyone. Before the entrance of man into the fishery, the stock of fish, P, is assumed to grow at a net natural rate, r, between two time periods. This r is equal to the recruitment of young fish joining the stock plus the growth of original fish in the stock less the natural fish mortality.

As man enters the fishery and starts to prey on fish, the situation evolves. By definition, r is now also the volume of fish, y, that can be caught by man in a sustained way without affecting the size of the stock. It is sustainable because with all of the natural growth in the stock captured by man, total stock will not grow but remains constant over time. Also, since man preys on fish and adds to their mortality, his activity may eventually lead to the reduction of P. This implies that the relationship between fishing effort, E, and P is inverse.

From the above relationships, a more in-depth examination will reveal that a U-shaped relationship exists between r or y and E. The relationship is one where at lower effort levels, the fish stock is high, causing overcrowding and slow growth. As fishing effort rises, the stock declines and crowding is lessened, causing faster growth. Finally, at too much effort, there is smaller stock to reproduce and growth slows down again.

In the U-shaped relationship between r or y and E, the point at which the level of effort yields the maximum r is the maximum sustainable point. Here, the fish catch by man is the biological optimum, the so-called maximum sustainable yield (MSY).

This biological theory, however, will not be a sufficient basis for marine resource planning and management where economic concerns are important. Hence, the biological theory has to be transformed into an economic theory. This transformation is facilitated by incorporating prices for fish catch and fishing effort to turn the biological parameters into economic parameters.

To illustrate the economic theory, the total revenue (TR), is generated by multiplying fish catch by the price of fish per unit of time. Then, total cost (TC) is derived by multiplying fishing effort by the price of effort per unit of time. If the prices of fish and effort are assumed constant, the resulting TR curve will be U-shaped while the TC curve is a straight line sloping upward (Figure 4).

Initially, economic theory explains that as E increases, TR also increases but at a decreasing rate. Continued increases in E bring the level of TR first to the economic optimum, the maximum economic yield or MEY. At MEY, the standard economic condition for profit maximization is met. From the economic standpoint, MEY is the most desirable exploitation level for the fishery.

If the fishery is efficiently run, fishing should stop at MEY where profits are at maximum. However, with complete open-access, fishing continues beyond MEY as more and more fishermen, motivated by profit, get into the fishery. This situation pushes the level of fishing past the economic optimum into the next optimum, the MSY, which as mentioned is the biological optimum of the fishery.

At the MSY level, positive profits still exist as TR remains greater than TC. This situation induces further fishing until, finally, the open access yield (OAY) is reached. At this point, positive profits are gone and, without any incentive to continue fishing, further human predation stops. The OAY is the long-run equilibrium point of the fishery.

In addition to the MEY, MSY and OAY, an economic indicator that is often used to measure sustainability in the fishery is the economic rent (ER). This is defined as the net return that occurs when the fishery is used in an economically optimal way and is equal to the excess profits—the difference between the overall economic value of the goods produced from the activity less the economic cost of production, where the cost is inclusive of normal profits (Schatz 1991, p. 3). Thus, ER is simply the profits at MEY. In this study, a minor change in the definition of economic rent is made. The term maximum economic rent (MER) is used to imply the profits at MEY. On the other hand, ER means the excess profit at any point of exploitation of the fishery.

4.2 Models

There are four general types of models which can be applied in the analysis of overfishing. These are the single species and constant price models, single species and variable price models, multiple species and constant price models and multiple species, and variable price models. The single species and constant price type of model was selected for this study due primarily to data constraints.

There are two single species and constant price models which are employed popularly in empirical research, the Gordon-Schaefer (GS) model, and the Fox Model.

The GS model originated from Gordon (1953) and Schaefer (1954, 1957) while the Fox model has its beginnings in Fox (1970). Mathematically, the GS model is specified as

$$Y = aE + bE^2 + u \qquad \text{........ (1)}$$

or

$$Y/E = a + bE + u \qquad \text{......... (2)}$$

where Y is fish catch, E is defined as before, a is the intercept, b is the coefficient and u is the error term. On the other hand, the Fox model is specified as

$$Y = E^{ec}+dE+u \qquad \text{.........(3)}$$

or

$$Y/E = ec+dE+u \qquad \text{.........(4)}$$

where c and d are the intercept and coefficient, respectively; e stands for exponent, and the other symbols are the same as before.

5.0 MARINE FISHERIES DATA

This section gives a summary of the data used in the study. A more detailed explanation of the step by step process involved in the construction of the data is contained in Israel and Banzon (1996), an earlier report of the results of the study.

5.1. Commercial Fisheries Data

5.1.1 Sources of Data

For commercial fisheries, secondary time-series data covering the period 1948-94 were used. The sources of data were the Bureau of Fisheries and Aquatic Resources (BFAR), Bureau of Agricultural Statistics (BAS) and past studies. The basic data for the sub-period 1948-87 were mainly from BFAR while those for 1988-94 were from BAS. Specifically, data were from the "Fisheries Statistics of the Philippines" of BFAR and the "Fishery Statistics", "Commercial Fishery Production Statistics", and "Selected Fishery Statistics" of BAS.

5.1.2 Fish Catch Data

The available time-series catch data from the sources for the two sub-periods were inconsistent. In particular, catch data for the first sub-period were underestimated while those for the latter were overestimated (Dalzell et al. 1987; Padilla and de Guzman 1994). To address this problem, the data were adjusted using a regression-based procedure. The final catch data for the whole 1948-94 period are shown in Table 4.

5.1.3 Fishing Effort Data

In past works, the most commonly accepted measure of fishing effort was fleet horsepower. This study used a modified measure for fishing effort which is the sum of engine and labor horsepower in the catch and carrier fleets of commercial fisheries, adjusted for learning effects.

Some problems were encountered in generating engine horsepower data for the commercial catch fleet. For the whole 1948-87 sub-period, BFAR did not gather information on the engine horsepower of catch vessels. It instead collected data on the tonnage and number of gears from earlier years. To address this inconsistency, the engine horsepower data series for the catch fleet was constructed based on the available raw data and by using a regression-based procedure. For the 1988-94 sub-period, no BAS data were available on which a measurement of engine horsepower of catch vessels could be based. Thus, the engine horsepower data were extrapolated using a procedure based on ratio and proportion.

Once the engine horsepower for the catch fleet was accounted for, the labor horsepower was computed. As there were no available data which could be used to directly measure labor horsepower, it was estimated by taking it as ratio of engine horsepower using data from Trinidad et al. (1993) and Karim (1985).

In the case of the commercial carrier fleet, engine horsepower data for earlier years were directly generated from Dalzell et al. (1987). To estimate data for latter years, engine horsepower was projected based on the average annual growth rate for earlier years. The data for carrier labor horsepower were measured using the same procedure used for estimating labor horsepower for the catch fleet.

After the engine and labor horsepower data for the catch and carrier fleets were generated, these were adjusted for learning effects. This final adjustment was done by using the learning factors developed by Silvestre et al. (1986) and later applied in Silvestre and Pauly (1987).

The fishing effort data used in the study are also provided in Table 4. Dividing the catch data by the fishing effort data gives CPUE data that are presented in the same table.

5.1.4 Prices of Fish and Fishing Effort Data

For this study, the price of commercial fish was estimated by averaging the market wholesale prices for major commercial fish species for 1994, based on BAS data. The price of fish used was P49,742 per metric ton. On the other hand, the cost of effort was based on 1988 data from Trinidad et al. (1993). The price was scaled upwards to 1994 figures to account for inflation. The price of fishing effort used was P16,043 per horsepower.

5.2 Municipal Fisheries Data

5.2.1 Sources of Data

This study used secondary time-series data for the municipal fisheries covering the period 1948-1994 from the "Fisheries Statistics of the Philippines" of BFAR, the "Fisheries Statistics" of BAS and Dalzell et al. (1987).

The "Fisheries Statistics of the Philippines" only has municipal catch data for 1976-87 and no effort data. On the other hand, the "Fishery Statistics" has catch data for later years but has no data on effort. Dalzell et al. (1987) has data on municipal small pelagic catch for the period 1948-85 from which the total municipal catch data can be estimated. It also has data on horsepower for the municipal fisheries for the same period.

5.2.2 Fish Catch Data

The data for 1948-75 were estimated from Dalzell et al. (1987) based on the assumption that catch in small pelagics comprised 38 percent of total municipal catch. The catch data for the latter years were simply lifted from the BFAR and BAS publications. Unlike in the commercial fisheries, there was no report of an underestimation of the municipal catch prior to 1965. Also, there was no sign of overestimation of the BAS data for 1988 and beyond as these appeared consistent with those for previous years. Hence the study did not adjust for underestimation or overestimation of catches data. The catch data for the whole 1948-94 period are shown in Table 5.

5.2.3 Fishing Effort Data

The fishing effort data for 1948-85 were lifted directly from Dalzell et al. (1987) and were the total of engine and labor horsepower. The figures for 1988-94 were estimated by getting the average annual growth rate of catch per unit effort for 1975-85 and then using this rate and the catch figures for the latter years to extrapolate both the catch per unit effort and effort.

The effort data from Dalzell et al. (1987) already includes both the engine and labor horsepower and, hence, a further adjustment was no longer necessary. There were no data indicating learning effects over time in municipal fishing and this prevented an adjustment related to learning. Lastly, the municipal fishermen in general use their catcher boats to also haul the catch to shore. Thus, no adjustment related to the use of carrier boats was needed. The fishing effort data and the CPUE data for the entire 1948-94 period are also presented in Table 5.

5.2.4 Prices of Fish and Fishing Effort Data

The price of fish from municipal waters per metric ton for 1994 was generated by averaging the market wholesale prices of the more popular municipal fish species, based on BAS data. The price of fish used was P28,250 per ton. There is no available data that can be used to estimate the cost of effort in the municipal fisheries. Therefore, it was simply assumed that this cost was one-half that of the commercial fisheries.

5.3 Total Marine Fisheries Data

5.3.1 Fish Catch and Fishing Effort Data

The data for the total marine fisheries for catch and effort were simply the summation of the catch and effort for commercial and municipal fisheries shown in Table 4 and Table 5. These figures and the subsequent CPUE data are provided in Table 6.

5.3.2 Prices of Fish Catch and Fishing Effort Data

The price of the fish from all marine waters per metric ton for 1994 was generated by averaging the market wholesale prices of the commercial and municipal fisheries. The price of fish used was P38,996 per ton. There were no available data useful for measuring the cost of effort in the whole marine fisheries sector. Thus, it was assumed that this amount is three-fourths that of the commercial fisheries.

6.0 FINDINGS

6.1 Results for Commercial Fisheries

6.1.1 Estimation of the GS and Fox Models for Commercial Fisheries

The results of the estimation of the biological specification of the GS and Fox models are provided in Table 7. As shown, the GS model had a higher adjusted coefficient of multiple determination. Both models generated the expected signs and significance for the coefficients suggesting that commercial fisheries are overfished.

6.1.2 Maximum Sustainable, Maximum Economic and Open Access Levels in Commercial Fisheries

Using the results of the GS model in Table 7 and the values for the price of fish and cost of effort for commercial fisheries, the MEY, Emey, MSY, Emsy, OAY and Eoay levels were computed (Table 8). As indicated, MSY was at 785,706 metric tons valued at P39.084 billion and produced at the effort level of 1,833,191 horsepower. When these estimated values were compared with catch and effort values in Table 4, the MSY level occurred back in the early 90s.

The MEY, on the other hand, was at 674,476 metric tons valued at P33.550 billion and produced at the effort level of 1,143,447 horsepower. Comparing this with the figures in Table 4, this level was attained back in the late 80s and early 90s.

The OAY was at 737,579 metric tons valued at P36.687 billion and produced at effort level of 2,286,894 horsepower. Figures in Table 4 indicate that this level has yet to happen, implying that with open access, further expansion of the sector will likely occur.

The results of estimation of the GS model of the commercial fisheries are illustrated in Figure 5.

6.1.3 Economic Rent in Commercial Fisheries

The computed total revenues, total costs and economic rents using the results of the GS model are also provided in Table 8. The MER that will be generated when the commercial fisheries are operated at MEY level is P15.205 billion per year. On the other hand, if operated at MSY, the ER is P9.673 billion annually. Expressed in terms of quantity at the 1994 average fish price of P49,742 per metric ton, the MER that can be had from the commercial fisheries per year amounts to 305,677 metric tons.

The above estimate of the amount of the MER from commercial fisheries, in general, is consistent with results of previous studies. Dalzell et al. (1987) determined that MER from small pelagic fisheries was about 366,000 metric tons. On the other hand, Silvestre and Pauly (1986) estimated the MER from the demersal fisheries at approximately 125,000 to 200,000 metric tons or an average 162,500 metric tons per year. When summed up, the MER from the small pelagic and demersal fisheries was at 528,500 metric tons.

Little is known about how much of small pelagic and demersal catch came from commercial fisheries. However, the average share of commercial fisheries catch to total marine fisheries catch in the last five years was 47 percent (BAS, Various Years). Using this as a rough basis, then the commercial fisheries share of the MER coming from the small pelagic and demersal fisheries was about 248,395 metric tons a year.

There is no information about the MER from large pelagic fisheries, much less the portion that goes to commercial fisheries. However, it can be assumed that the difference between the figure of 248,395 metric tons from past studies and the figure of 305,677 metric tons computed in this study represents the economic rent from large pelagic fisheries.

6.1.4 Required Reduction of Fishing Effort in Commercial Fisheries

Based on the above results, fishing effort needs to be reduced from the 1994 level of 2,091,899 horsepower (Table 4). In percentage terms, effort in the commercial fisheries sector will have to be reduced by about 45 percent to arrive at MEY. To attain the MSY, on the other hand, it will have to be lowered by approximately 12 percent.

6.2 Results for Municipal Fisheries

6.2.1 Estimation of the GS and Fox Models for Municipal Fisheries

The results of the estimation of the GS and Fox models for the municipal fisheries are presented in Table 9. As indicated, the latter had a higher adjusted coefficient of multiple determination. Both GS and Fox models had the expected signs and significance for the coefficients implying that municipal fisheries are overfished.

6.2.2 Maximum Sustainable, Maximum Economic and Open Access Levels in Municipal Fisheries

For consistency, the GS model again was utilized to estimate the MSY, MEY and OAY for municipal fisheries (Table 10). The MSY was at 1,058,263 metric tons valued at P29.89 billion and attained at effort level of 3,823,204 horsepower. Compared with the catch and effort levels in Table 5, the MSY in the municipal fisheries was reached in the late 80s and early 90s.

In contrast, the MEY was at 779,824 metric tons valued at P22 billion and attained at the effort level of 1,862,123 horsepower. Comparing with figures in Table 5, this level was attained back in the early 80s.

The OAY was at 1,057,554 metric tons valued at P29.87 and achieved at the effort level of 3,724,246 horsepower. Compared to figures in Table 5, it appeared that this level was attained in the early 90s.

An illustration of the GS model for commercial fisheries is presented in Figure 6. A rather unique situation in the municipal fisheries is that the OAY was attained before the MSY was reached, in contrast to the situation in the commercial fisheries.

6.2.3 Economic Rent in Municipal Fisheries

Table 10 also contains the computed total revenues, total costs and economic rents using the results of the GS model. If operated at MEY, the MER that can be derived from the municipal fisheries is about P7.095 billion per year. If operation is at MSY, the ER is negative, at P.77 billion annually. At the assumed 1994 average price for municipal fish species of P28,250 per metric ton, the MER that will be derived from municipal fisheries amounts to 251,047 metric tons.

Again, this result was consistent with those of previous studies. The estimated MER from the small pelagic and demersal fisheries was at 528,500 metric tons. Assuming that the average share of municipal fisheries catch to marine fisheries catch was 53 percent, then the municipal fisheries share of the MER coming from the small pelagic and demersal fisheries was about 280,105 metric tons a year.

While there is no information on the MER from large pelagic fisheries, it can be assumed that large pelagic species are mostly caught by commercial fishermen. Therefore, the extrapolated MER of 280,105 metric tons for small pelagic and demersal fisheries can be taken as the rent for municipal fisheries as a whole. This figure is clearly not way off that derived in the study.

6.2.4 Required Reduction of Fishing Effort in Municipal Fisheries

To attain sustainable levels, the fishing effort in municipal fisheries has to be lowered from the level of 6,343,329 horsepower in 1994 (Table 5). Percentage-wise, fishing effort will have to decrease by 71 percent to attain MEY. To get to the MSY level, on the other hand, it will have to be reduced by 40 percent. (It should be noted, however, that since MSY falls beyond the OAY level, it is not a desirable management objective in this case.)

6.3 Results for Overall Marine Fisheries

6.3.1 Estimation of the GS and Fox Models for Overall Marine Fisheries

Table 11 presents the results of the estimation of the GS and Fox models for the overall marine fisheries sector. The former model had a higher adjusted coefficient of multiple determination. Also, both models generated the sign significance for the coefficients which were expected, implying that the problem of overfishing occurs for marine fisheries as a whole. (This result, however, is anticipated given that both the commercial and municipal fisheries were found earlier to be overfished.)

6.3.2 Maximum Sustainable, Maximum Economic and Open Access Levels in Overall Marine Fisheries

The estimates of the MSY, MEY and OAY for marine fisheries are provided in Tables 12. The MSY was at 1,803,727 metric tons valued at P70.3 billion and arrived at effort level of 5,505,882 horsepower. Contrasted to the catch and effort figures in Table 6, the MSY was reached in the late 80s and early 90s.

The MEY was at 1,403,728 metric tons valued at P54.7 billion and generated at the effort level of 2,913,072 horsepower. Contrasted to figures in Table 6, this level was attained in the early 80s.

Lastly, the OAY was at 1,797,624 metric tons valued at P70.1 billion and attained at the effort level of 5,826,143 horsepower. Compared to figures in Table 6, this was reached in the early 90s.

An illustration of the GS model for overall marine fisheries is shown in Figure 7.

6.3.3 Economic Rent in Overall Marine Fisheries

The computed total revenues, total costs and economic rents using the GS model are also shown in Table 12. At MEY, the MER that can be derived from the overall marine fisheries is about P19.689 billion per year. At MSY, the ER is at P4.091 billion annually.

The generated MEY and MSY levels for the overall marine fisheries divert a bit from the sum of the derived MEY and MSY levels for commercial and municipal fisheries (Tables 8 and 10). This result was expected given the differences in fish catch and fishing effort prices utilized in the computations. At the assumed 1994 average price for marine fish species of P38,996 per metric ton, the MER that can be had amounts to 504,916 metric tons. Again, this figure is generally consistent with those generated from previous studies.

6.3.4 Required Reduction of Fishing Effort in Overall Marine Fisheries

The above result implies that the fishing effort in overall marine fisheries has to be decreased from the level of 8,435,228 horsepower in 1994 (Table 6). In particular, fishing effort will have to decrease by 65 percent to attain MEY. On the other hand, it will have to lower by 35 percent to attain MSY.

6.4 Employment Impacts of Reduction in Effort in Marine Fisheries

A reduction in fishing effort to attain MSY or MEY will raise the productivity of marine fisheries. However, it will also result in the unemployment of fishermen who will be eased out of fisheries. This is a major problem in the country where the rest of the economy may not have enough room to accommodate the displaced fishermen.

While limitations in available employment data make it difficult to estimate exactly employment effects of a reduction in effort, it was nevertheless attempted here to get some preliminary estimates of potential impacts. The results are provided in Table 13. There are two computational approaches used: first, by using the previous results for commercial and municipal fisheries individually and then summing up; and second, by using the previous results for the overall marine fisheries directly.

Based on the 1990 figure of about 1 million total fishermen and fish-farmers and annual growth rates of the general population thereafter, the 1994 total fishermen and fish-farmers was 1,103,230. Of these, 29 percent (319,937) were commercial fishermen while 36 percent (397,163) were municipal fishermen (see Figure 1).

To attain MSY, effort will be decreased by 12 percent in the commercial fisheries and 40 percent in the municipal fisheries. If this reduction is applied equally to labor and engine horsepower, then commercial fishermen will be reduced by 38,392 while municipal fishermen will be lowered by 158,865. In total, using the previous individual results for the commercial and municipal fisheries, the number of marine fishermen will decrease by 197,258.

When results for overall marine fishermen were used, effort will be reduced by 35 percent to attain MSY. This means that 250,985 fishermen will lose their jobs. (Again, it must be noted that computations based on individual and total results differ due to reasons already stated.) Thus, about one-fifth to quarter of a million fishermen will be unemployed if MSY is to be attained in the marine fisheries.

To arrive at MEY, on the other hand, effort must be lowered by 45 percent in the commercial fisheries and by 71 percent in the municipal fisheries. Again, if this reduction is applied equally to labor and engine horsepower, then commercial fishermen will be reduced by 143,972 and municipal fishermen will be lowered by 281,986 for a sum of 425,957.

If results for overall marine fishermen were utilized, effort will be lowered by 65 percent to get MEY. This means that 466,115 people will be unemployed. Thus, from this and the above results, approximately half a million fishermen will be unemployed if MSY is to be attained in the marine fisheries.

In brief, it appears that a large number of fishermen will lose their jobs if sustainability is attained in marine fisheries. Since the country already has a serious unemployment problem, this fishery management concern cannot be ignored.

7.0 CONCLUSIONS AND RECOMMENDATIONS

7.1 Conclusions

From the results of estimation, the study generated the following conclusions about overfishing in the marine fisheries sector:

(a) The marine fisheries sector and its two sub-sectors, commercial and municipal fisheries are already overfished. This sector-based finding is consistent with results of previous studies employing species-based analysis.

(b) In general, MEY and MSY levels in the marine fisheries sector and its sub-sectors were reached during the early 80s to the early 90s.

(c) Substantial economic rents can be had if the marine fisheries sector is operated at sustainable levels. Taken separately, if operated at MEY, MER from the commercial fisheries will be about P15.205 billion at 1994 prices while that from the municipal fisheries will be approximately P7.095 billion. Taken as a whole, the MER from the marine fisheries sector will be P19.689 billion.

(d) Substantial reduction in fishing effort will be required to reach sustainable levels in the marine fisheries. Considered separately, if operated at MEY, effort in commercial fisheries will be decreased by 45 percent while that in the municipal fisheries will be lowered by 71 percent. Taken as a whole, for marine fisheries, effort must be decreased by 65 percent.

(e) Because of the needed substantial decreases in fishing effort for the attainment of sustainability in the marine fisheries, unemployment will likely be a serious potential side effect. Preliminary estimates show that taken individually, approximately 144,000 commercial fishermen and 290,000 municipal fishermen will lose their jobs if the MEY level is attained in the sub-sectors. Overall, about 466,000 marine fishermen will be unemployed.

Before recommendations can be derived from the aforementioned conclusions, however, caveats have to be stated. First, the exploitation levels and economic rents generated by the study depend to a large extent on the price of fish and cost of effort assumed in the analysis. A decreased price of fish or an increased cost of effort, for instance, may substantially reduce the value of the estimated economic rent that can be generated from the sector, and vice versa. The prices of fish and fishing effort used were considered the best estimate in the absence of any other source. In the future, a study that will use more accurate data reflecting variable -- instead of fixed -- fish and effort prices will be useful.

Next, it must be pointed out that since some of the annual data (e.g., horsepower in the later years and catch in earlier years for the commercial fisheries) were simply estimated, there will be concerns as to the reliability and accuracy of the final data used. The data on effort after 1988, in particular, were adjusted upwards to match the overestimated catch data and maintain the trend in the catch per unit effort. Suffice it to say here that the particular procedures were applied to put to use the available catch data. A re-estimation using more reliable catch and effort data in the future will be welcome.

Third, the GS and Fox models are partial models in that they only consider fishing effort as the factor influencing fish catch. Although learning (and, hence, in a way, technology), has been imputed as a factor, other determinants of fish catch were excluded, such as fisheries policies or annual changes in weather. The extent by which these and other factors influence fishing has not been investigated here and should be considered in a future study.

Finally, as already mentioned, the data used for the estimation of the employment impacts of fishing effort reduction are limited. Thus, while it can be argued that the unemployment impacts will be large, care must be exercised in the interpretation of the exact unemployment figures generated. A study that will utilize a detailed time-series employment data in fisheries and a more sophisticated way of predicting unemployment impacts will be needed in the future.

7.2 Recommendations

7.2.1 Recommendations for Commercial Fisheries

Based on the findings of the study, some recommendations related to the improvement of the commercial fisheries sector are suggested. First and foremost, since the sector is already overfished, this problem must be immediately addressed by controlling total fishing effort. At present, the Fisheries Sector Program (FSP) is in the process of devising a program to effect effort reduction. Once this program is ready, it must be seriously considered, if not immediately implemented, by the authorities.

Without pre-empting FSP efforts, some important points can be raised here in the development of a long-term program for effort reduction. First, any future reduction must be done so that the expected costs of reduction (e.g., administrative costs, rent seeking costs), will be less than the expected gains from the reduction (e.g., public revenues, production efficiency, sustainable resource use).

Another point that should be raised is that in the search for immediate solutions to overfishing, a practical approach which can be done is to substantially raise the license fee rates currently imposed in the commercial fisheries. At present, the license fees are very low to effect any real effort reduction (for an example, see Schatz 1991). Using the license system to help reduce effort has a distinct advantage in that the fishery authorities already have long experience in using it.

There is doubt, however, that the licensing system will be effective in reducing fishing effort in the long-term. There is the danger that the burden of higher license rates will just be transferred by commercial fishermen to the final consumers via higher prices for the catch. Thus, it is necessary that over the long-term, other measures should be considered by the fishery authorities. A study that will look into other probable solutions to overfishing should be conducted.

It should also be remembered that while the commercial fisheries sector may have a high MER computed in this study, the actual economic rent it has been enjoying at present may be much less, given that it is operating close to open access equilibrium. So as not to encourage sudden dislocation and closure among the commercial fishermen, any effort reduction scheme must be applied gradually. For instance, if higher license rates are to be imposed, the established new rates initially must be set way below what can capture the whole MER. In addition, the increases in license rates must be done gradually to allow adjustment among the fishermen. In the first year of implementation, for instance, the rates may not be more than 20 percent of the final targeted maximum rates for the attainment of sustainability. Then, the rates can be increased at the same percentage every two years or so thereafter.

The problem of displaced commercial fishermen once an effective effort-reducing scheme is in place should be a matter of serious concern. As many fishermen have limited skills outside their profession, it will be difficult to employ the displaced in other economic sectors. Hence, a retraining and employment program may be necessary. A potential option is for the national government and private sector to pool their resources and organize such a program.

Over and above what has already been suggested, it must be emphasized that the use of instruments to reduce fishing effort must be accompanied by strong reforms in the enforcement side. In particular, the illegal underground economy in fisheries (e.g. commercial operators reportedly using unlicensed duplicate boats) must be curtailed. Furthermore, reducing poaching by foreign vessels in local waters is a necessity. It also goes without saying that strictly penalizing the offenders according to law is needed if future unlawful activities are to be discouraged.

Finally, although the commercial fisheries as a whole may be overfished, there may be sub-sectors within (e.g., specific fishing areas and commercial species), which currently remain under-exploited. The development of these sub-sectors must also be afforded priority in fisheries management. It is the challenge of government to be able to control overexploitation at the national level while promoting further development in certain pockets in the commercial fisheries at the same time.

7.2.2 Recommendations for Municipal Fisheries

As overfishing also exists in the municipal fisheries, there is the same need to address the problem. An isolated policy to simply lower effort will likely be more politically difficult to implement here than in the commercial fisheries. This is because municipal fishing is largely subsistence in nature and a matter of survival for fishermen. Forcing them out of their livelihood without an acceptable alternative employment program will be viewed by many as inequitable and morally unacceptable.

Because of the above problem, it is only through the explicit provision of alternative livelihood opportunities that municipal fishermen can be made to leave the fishery. To effect this, small-scale livelihood programs must be promoted by the government in coastal areas in cooperation with the local government units and non-government organizations. At present, alternative livelihood programs are already implemented in some areas. These activities need to be implemented countrywide to help effect reduction of fishing effort at the national level.

An option that should be looked into in the search for alternative livelihoods is the promotion of eco-tourism in suited rural coastal areas. The more fishermen employed in the eco-tourism establishments, the less will be fishing effort. Another option that the government can consider is the dispersion of industrial development into the rural coastal areas. The more industries and other economic activities that employ the municipal fishermen, the less likely that fishermen will engage in fishing activities.

The promotion of resource and environmental education in fishing communities is another means of reducing fishing effort. As municipal fishermen become aware of the dangers that overfishing poses to their welfare, the more likely they will practice sustainable fishing activities. The growing number of education and awareness projects in fisheries is a big step in the right direction and must be continuously supported by the government.

The faster implementation and operationalization of the Local Government Code (LGC) in rural coastal areas will help promote effort reduction in municipal fisheries also. As the code empowers local governments and people organizations to manage coastal resources in a sustainable manner, its actual implementation should result in the development by the local stakeholders of effective management systems, such as those relating to coastal property rights and access; rules and ordinances; monitoring, policing and enforcement; and others that will result in the sustainable exploitation of municipal fishery resources.

7.2.3 Recommendations for Overall Marine Fisheries

Finally, for the marine fisheries as a whole, it should be remembered that overfishing is brought about not only by increased fishing effort but also by the employment of destructive gears and techniques by fishermen. Hence, to help conserve marine fisheries resources, the effective enforcement of the fishery laws, rules and regulations related to destructive gears must be pursued.

To close, while reduction of fishing effort should be a primary goal in the marine fisheries, the impacts of such reduction in terms of equity is no less important. Hence, for overall marine fisheries, a strong balance between efficiency and equity objectives must be maintained. If in the end, for instance, a reduction in fishing effort will only result in the monopolization of the fisheries sector by a few efficient big-time operators, then sustainable development in the sector will have been attained at a steep price.

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Figure 1. Total Fishing Effort for Small Pelagic and Demersal Fishes, 1965-1985

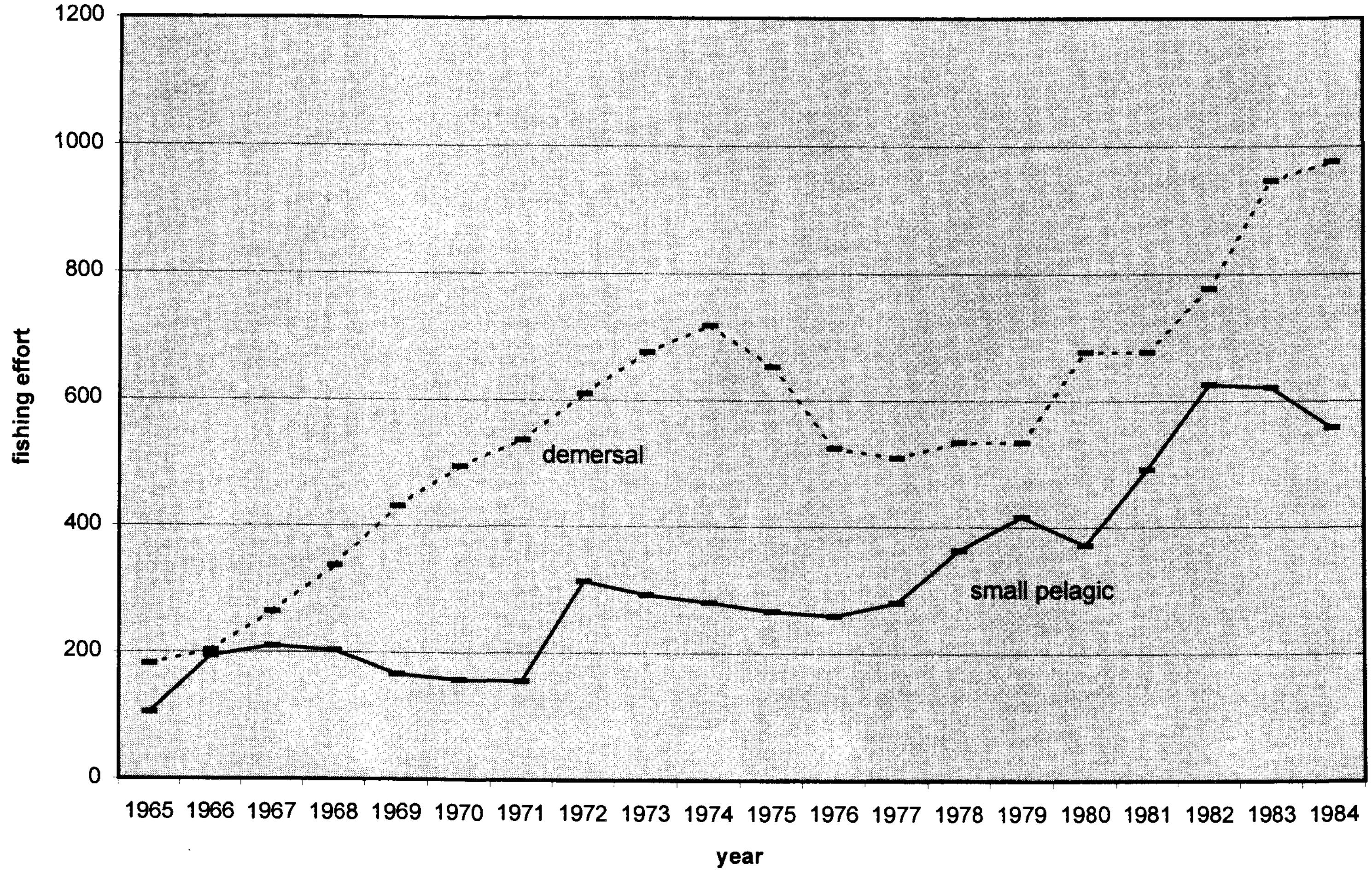

Figure 2. Catch Per Unit Effort for Small Pelagic and Demersal Fishes, 1965-1985

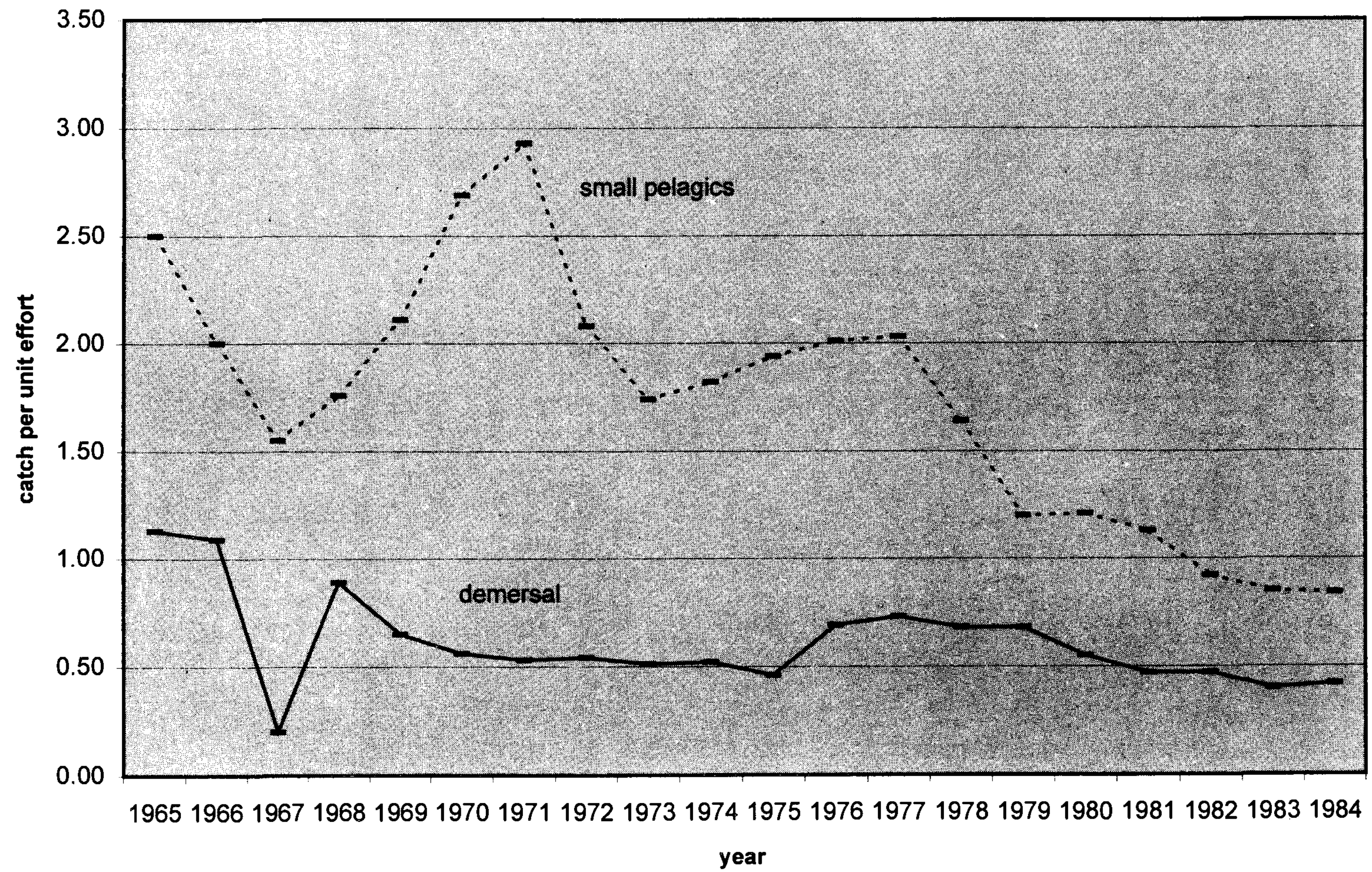

Figure 3. The Basic Economic Theory of Overfishing

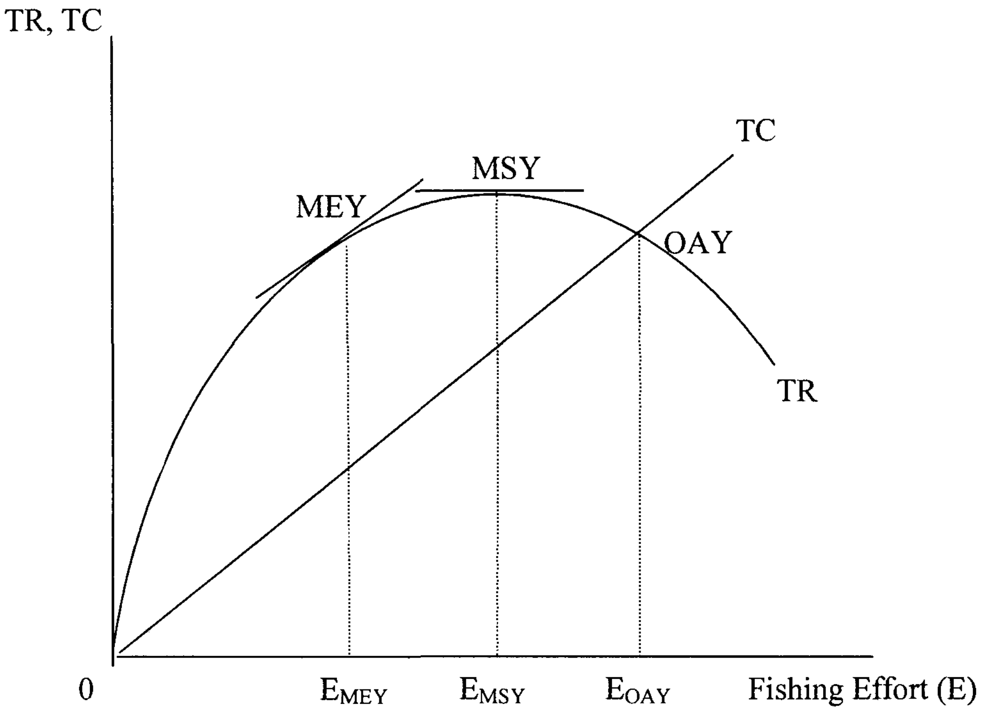

Figure 4. Results of the Estimation of the Gordon-Schaefer Model for the Commercial Fisheries, 1948-1994

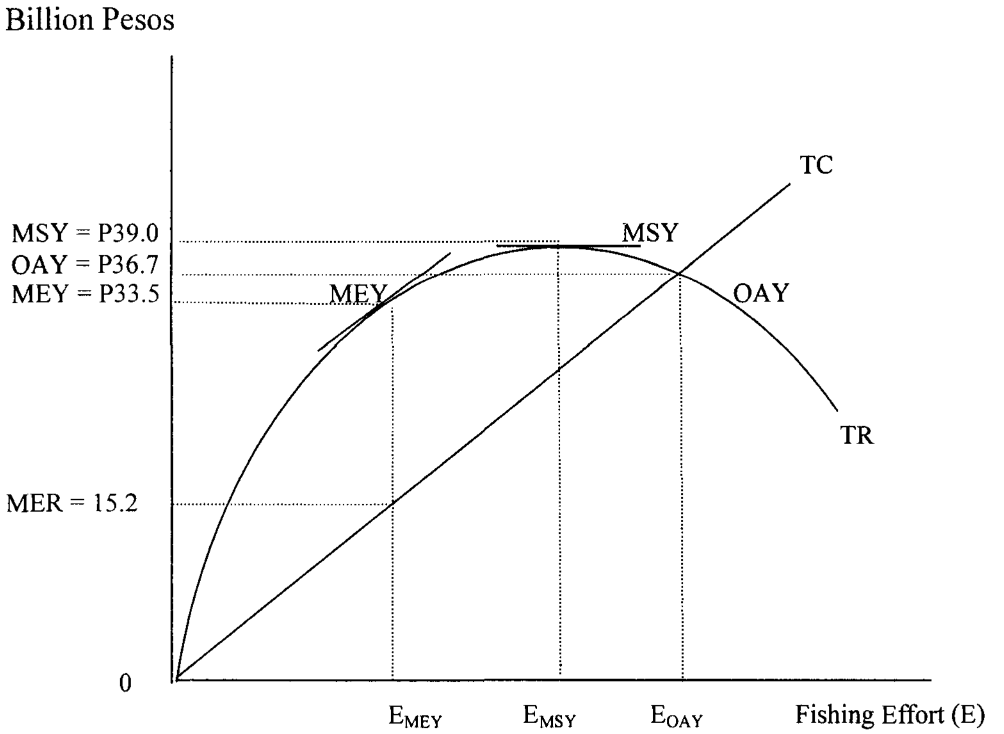

Figure 5. Results of the Estimation of the Gordon-Schaefer Model for the Municipal Fisheries, 1948-1994

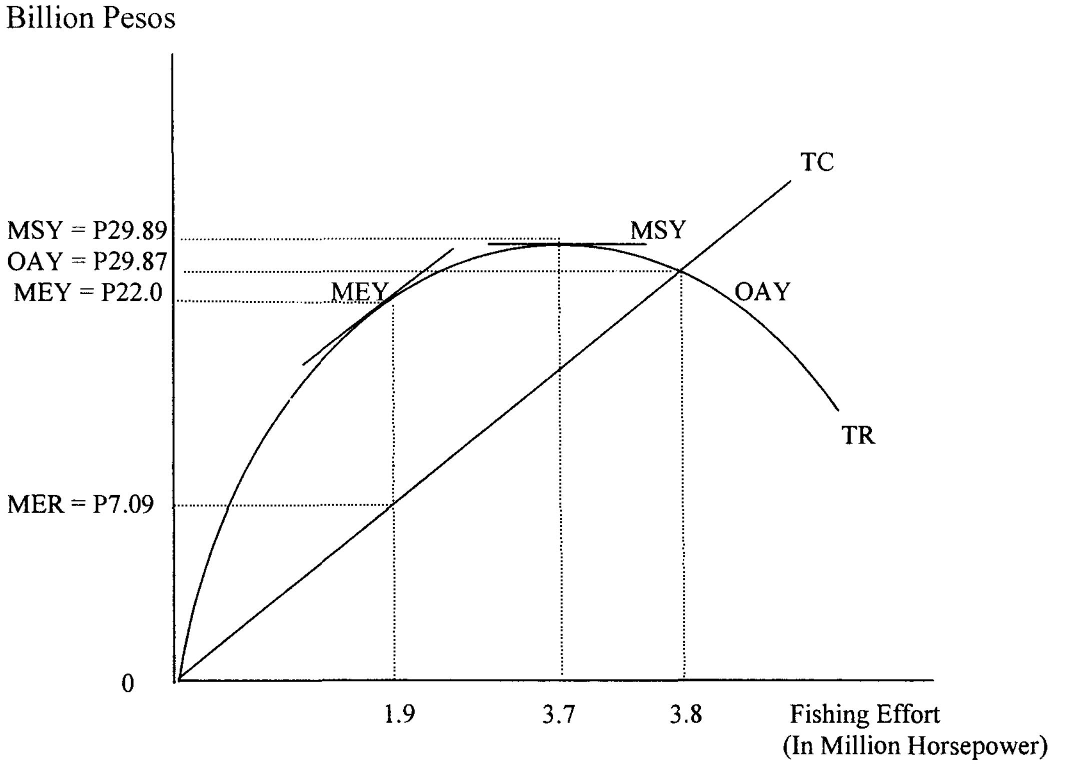

Figure 6. Results of the Estimation of the Gordon-Schaefer Model for the Overall Marine Fisheries, 1948-1994

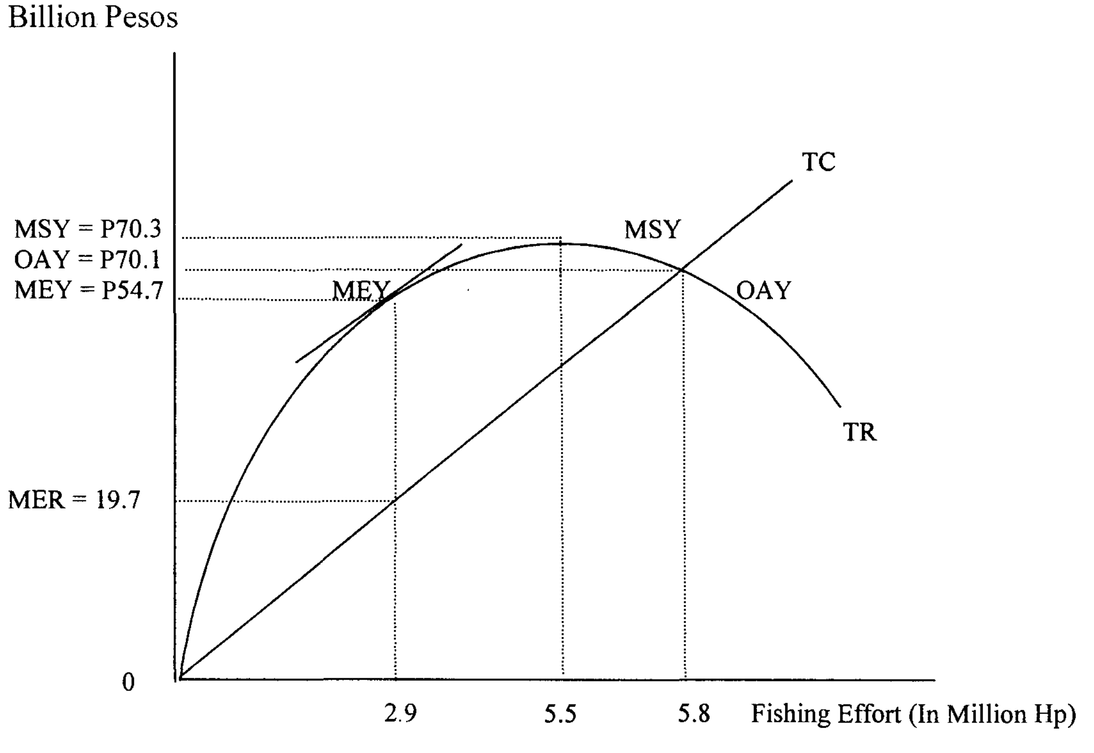

Figure 7. Distribution of Employment in the Fishery Sector, 1990

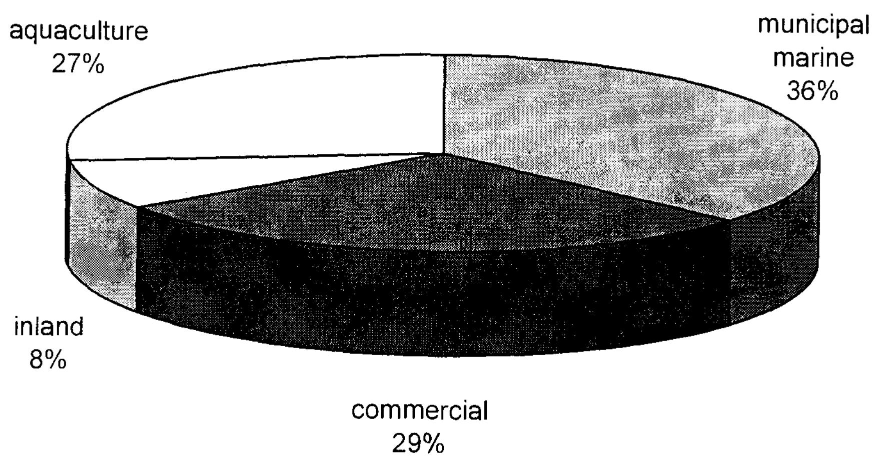

Table 1: Quantity (Thousand MT) and FOB Value (Million P) of Fish Production in the Philippines, by Sector, 1981-1994.

Year	All Sectors		Commercial		Municipal Marine		Aquaculture		Inland Fishing	
	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value
1981	1,774	13,955	495	4,125	710	6,264	340	2,866	229	700
1982	1,896	15,064	526	4,355	708	6,488	392	3,393	270	828
1983	2,110	18,982	519	4,643	771	7,463	445	4,799	375	2,077
1984	2,080	25,650	513	6,521	790	10,291	478	7,266	299	1,572
1985	2,052	31,297	512	7,857	785	12,796	495	8,724	260	1,920
1986	2,089	37,331	546	9,248	807	14,611	471	10,832	265	2,640
1987	2,213	37,350	591	9,821	816	14,217	561	11,421	245	1,891
1988	2,270	42,118	600	10,272	838	14,693	600	15,213	232	1,940
1989	2,371	45,094	637	11,033	883	16,182	629	15,673	222	2,206
1990	2,504	52,177	701	12,411	895	16,736	671	20,466	237	2,564
1991	2,599	60,034	760	15,245	914	19,614	692	22,656	233	2,519
1992	2,626	65,443	805	16,801	855	19,444	736	25,986	230	3,212
1993	2,647	71,058	845	18,365	803	20,118	772	30,508	227	2,067
1994	2,686	81,229	883	21,130	787	22,327	791	35,280	223	2,492
Average Annual Growth Rate (%)	3	14.84	4.62	13.76	0.88	10.77	6.87	22.01	0.69	16.87

Source: BAS. "Selected Fisheries Statistics".

Table 2: Quantity (MT) and FOB Value (Milion P) of Exports and Imports of Fishery Products by the Philippines, 1981-1994.

Year	Exports		Imports		Net Exports	
	Quantity	Value	Quantity	Value	Quantity	Value
1981	83,736	1,251	46,850	288	36,886	963
1982	68,265	1,120	83,445	444	(15,180)	676
1983	75,589	1,593	23,038	111	52,551	1,482
1984	63,055	2,179	6,097	50	56,958	2,129
1985	95,077	3,496	28,755	118	66,322	3,378
1986	101,453	4,883	69,085	386	32,368	4,497
1987	111,830	6,442	104,936	637	6,894	5,805
1988	128,903	9,599	164,575	1,312	(35,672)	8,287
1989	145,099	10,248	197,966	1,424	(52,867)	8,824
1990	143,038	11,529	196,115	1,854	(53,077)	9,675
1991	144,939	14,048	193,635	2,323	(48,696)	11,725
1992	131,915	11,090	221,545	2,496	(89,630)	8,594
1993	163,745	14,074	208,895	2,249	(45,150)	11,825
1994	172,080	15,027	241,194	2,505	(69,114)	12,522
Average Annual Growth Rate (%)	7.03	23.33	45.77	40.87	-41.9	26.99

Source: BAS. "Selected Fisheries Statistics".

Table 3: Fishing Effort and Catch per unit Effort for Small Pelagic and Demersal Fish Species in the Philippines, 1965-85.

Year	Small Pelagics		Demersals	
	Effort ('000 Hp)	CPUE (Mt / Hp / y)	Effort ('000 Hp)	CPUE (Mt / Hp / y)
1965	105	2.50	182	1.13
1966	194	2.00	203	1.09
1967	210	1.55	264	0.20
1968	203	1.76	337	0.89
1969	166	2.11	431	0.65
1970	157	2.69	494	0.56
1971	155	2.93	536	0.53
1972	313	2.08	610	0.54
1973	292	1.74	676	0.51
1974	280	1.82	718	0.52
1975	266	1.94	653	0.46
1976	259	2.01	524	0.69
1977	280	2.03	509	0.73
1978	363	1.64	534	0.68
1979	416	1.20	534	0.68
1980	371	1.21	677	0.55
1981	491	1.13	677	0.47
1982	625	0.92	777	0.47
1983	621	0.85	946	0.40
1984	557	0.84	976	0.42
1985	558	0.84	-	-
Ave. Annual Growth Rate (%)	11.93	-4.07	10.04	10.83

Sources: Silvestre and Pauly (1987) and Dalzell et.al. (1987).A31

Table 4: Catch, Effort and Catch per unit Effort in the Philippine Commercial Fisheries, 1948-94.

Year	Catch (Mt)	Effort (Hp)	CPUE
1948	85,653	24,247	3.53250
1949	113,310	41,889	2.70500
1950	133,325	57,485	2.31770
1951	161,584	83,800	1.92820
1952	180,787	104,359	1.73240
1953	178,539	101,839	1.75310
1954	192,090	117,487	1.63500
1955	191,270	116,509	1.64170
1956	189,295	114,570	1.65800
1957	183,684	107,651	1.70630
1958	208,102	137,381	1.51480
1959	214,935	146,332	1.46880
1960	214,877	146,256	1.46920
1961	227,180	163,063	1.39320
1962	243,969	187,437	1.30160
1963	271,604	231,158	1.17500
1964	279,811	245,002	1.14210
1965	300,174	310,237	0.96720
1966	314,899	392,013	0.80330
1967	330,922	422,195	0.78380
1968	406,794	409,450	0.99350
1969	368,727	439,560	0.83890
1970	381,877	484,615	0.78800
1971	382,276	460,943	0.82930
1972	424,754	553,994	0.76670
1973	465,422	634,416	0.73360
1974	470,675	620,618	0.75840
1975	498,617	601,506	0.82890
1976	508,197	633,966	0.80160
1977	518,165	549,419	0.94310
1978	505,840	577,953	0.87520
1979	500,747	712,080	0.70320
1980	488,478	775,780	0.62970
1981	494,768	900,325	0.54950
1982	526,273	981,712	0.53610
1983	519,346	1,055,844	0.49180
1984	513,335	969,779	0.52930
1985	511,987	1,003,392	0.51030
1986	546,230	983,919	0.55520
1987	591,192	1,077,893	0.54850
1988	599,995	1,149,098	0.52210
1989	637,138	1,265,398	0.50350
1990	700,564	1,428,673	0.49040
1991	759,815	1,597,473	0.47560
1992	804,866	1,756,049	0.45830
1993	845,431	1,918,635	0.44060
1994	885,446	2,091,899	0.42330

Table 5: Catch, Effort and Catch per unit Effort in the Philippine Municipal Fisheries, 1948-94.

Year	Catch (Mt)	Effort (Hp)	CPUE
1948	130,052	45,258	2.87
1949	158,669	54,899	2.89
1950	146,793	61,197	2.40
1951	197,393	68,220	2.89
1952	208,706	76,053	2.74
1953	199,266	84,789	2.35
1954	205,371	94,534	2.17
1955	218,983	105,403	2.08
1956	248,509	117,528	2.11
1957	253,808	131,051	1.94
1958	257,166	146,139	1.76
1959	260,573	162,969	1.60
1960	264,481	181,748	1.46
1961	268,448	202,689	1.32
1962	272,475	226,055	1.21
1963	276,562	252,124	1.10
1964	282,726	281,208	1.01
1965	303,930	313,657	0.97
1966	326,725	349,862	0.93
1967	351,229	390,256	0.90
1968	444,179	435,326	1.02
1969	477,492	485,614	0.98
1970	510,546	768,673	0.66
1971	542,904	604,336	0.90
1972	598,733	674,199	0.89
1973	639,795	752,154	0.85
1974	684,498	839,143	0.82
1975	731,725	936,211	0.78
1976	619,145	1,044,531	0.59
1977	712,514	936,115	0.76
1978	775,932	1,300,017	0.60
1979	635,543	1,450,905	0.44
1980	647,284	1,559,870	0.41
1981	709,989	1,806,252	0.39
1982	708,016	2,015,449	0.35
1983	770,988	2,248,911	0.34
1984	789,975	2,509,457	0.31
1985	785,132	2,800,208	0.28
1986	807,275	3,152,262	0.26
1987	816,247	3,489,601	0.23
1988	838,346	3,924,015	0.21
1989	882,369	4,521,795	0.20
1990	895,040	5,021,765	0.18
1991	913,524	5,611,605	0.16
1992	854,687	5,748,140	0.15
1993	803,194	5,914,174	0.14
1994	786,847	6,343,329	0.12

Table 6: Catch, Effort and Catch per unit Effort in the Philippine Marine Fisheries, 1948-94.

Year	Catch (Mt)	Effort (Hp)	CPUE
1948	215,705	69,505	3.1034
1949	271,979	96,788	2.8101
1950	280,028	118,682	2.3595
1951	358,977	152,020	2.3614
1952	389,493	180,412	2.1589
1953	377,805	186,628	2.0244
1954	397,461	212,021	1.8746
1955	410,253	221,912	1.8487
1956	437,804	231,698	1.8895
1957	437,492	238,702	1.8328
1958	465,268	283,520	1.6410
1959	475,508	309,301	1.5374
1960	479,358	328,004	1.4614
1961	495,628	365,752	1.3551
1962	516,444	413,492	1.2490
1963	548,166	483,282	1.1343
1964	562,537	526,210	1.0690
1965	604,004	623,894	0.9681
1966	641,624	741,875	0.8649
1967	682,151	812,451	0.8396
1968	850,973	844,776	1.0073
1969	846,219	925,174	0.9147
1970	892,423	1,253,288	0.7121
1971	925,180	1,065,279	0.8685
1972	1,023,487	1,228,193	0.8333
1973	1,105,217	1,386,570	0.7971
1974	1,155,173	1,459,761	0.7913
1975	1,230,342	1,537,717	0.8001
1976	1,127,342	1,678,497	0.6716
1977	1,230,679	1,485,534	0.8284
1978	1,281,772	1,877,970	0.6825
1979	1,136,290	2,162,985	0.5253
1980	1,135,762	2,335,650	0.4863
1981	1,204,757	2,706,577	0.4451
1982	1,234,289	2,997,161	0.4118
1983	1,290,304	3,304,755	0.3904
1984	1,303,310	3,479,236	0.3746
1985	1,297,119	3,803,600	0.3410
1986	1,353,505	4,136,181	0.3272
1987	1,407,439	4,567,494	0.3081
1988	1,438,341	5,073,114	0.2835
1989	1,519,507	5,787,193	0.2626
1990	1,595,604	6,450,438	0.2424
1991	1,673,339	7,209,079	0.2321
1992	1,659,553	7,504,191	0.2212
1993	1,648,625	7,832,810	0.2105
1994	1,672,293	8,435,228	0.1983

Table 7: Regression Results for the Gordon-Schaefer and Fox Models in the Philippine Commercial Fisheries, 1948-94.

Specification	Model	a1	a2	Adjusted R2
Catch= a Effort+ b Effort2	Gordon-Schaefer	.8572* -21.676	-2.338E-07 (-8.654)	0.85
Catch= Effort Exp (c+d Effort)	Fox	.4588*	-0.000000888	0.76

Figures in Parenthesis are t-values.
*means significant at the 1 percent level.
(a) Catch and Effort are in quantity terms.

Table 8: Key Indicators Using the Gordon-Schaefer Model Results in the Philippine Commercial Fisheries, 1994.

Indicator	Volume of Catch	Total Revenues	Amount of Effor	Total Costs	Maximum Economic Rent/
Maximum Sustainable Point	785,706	39,082,565,981	1,833,191	29,409,879,384	9,672,686,597
Maximum Economic Point	674,476	33,549,785,675	1,143,447	18,344,318,773	15,205,466,902
Open Access Point	735,579	36,688,637,546	2,286,894	36,688,637,546	-

Table 9: Regression Results for the Gordon-Schaefer and Fox Models in the Philippine Municipal Fisheries, 1948-94.

Specification (a)	Model	a1	a2	R2
Catch = a1 Effort + a2 Effort2	Gordon-Shaefer	.5536* -15.42	-7.24E-08 (-10.145)	0.55
Catch = Effort (a1+ a2 Effort)	Fox	.3761* -5.202	-0.00000046 (-15.044)	0.83

Figures in parenthesis are t-values.
*means significant at the 1 percent level.
(a) Catch and Effort are in quantity terms.

Table 10: Key Indicators Using the Gordon-Shaefer Model Results in the Philippine Municipal Fisheries, 1994.

Indicator	Volume of Catch (Metric tons)	Total Revenue (Pesos)	Amount of Effort (Horse Power)	Total Costs (Pesos)	Economic Rent (Pesos)
Maximum Sustainable Point	1,058,263	29,895,929,282	3,823,204	30,669,745,856	(773,816,575)
Maximum Economic Point	779,824	22,030,031,369	1,862,123	14,937,950,032	7,092,081,338
Open Access Point	1,057,554	29,875,900,064	3,724,246	29,875,900,064	-

Table 11: Regression Results for the Gordon-Schaefer and Fox Models in the Philippine Marine Fisheries, 1948-94.

Specification (a)	Model	a1	a2	Adjusted R2
Catch = a1 Effort + a2 Effort2	Gordon-Shaefer	.6552* -17.054	-5.95E-08 (-10.043)	0.66
Catch = Effort (a1+ a2 Effort)	Fox	0.389* -6.039	-0.000000299 -14.647	0.62

Figures in parenthesis are t-values. *means significant at the 1 percent level.
(a) Catch and Effort are in quantity terms.

Table 12: Key Indicators Using the Gordon-Shaefer Model Results in the Philippine Marine Fisheries, 1994

Indicator	Volume of Catch (Metric tons)	Total Revenue (Pesos)	Amount of Effort (Horse Power)	Total Costs (Pesos)	Economic Rent (Pesos)
Maximum Sustainable Point	1,803,727	70,338,140,386	5,505,882	66,246,776,471	4,091,363,915
Maximum Economic Point	1,403,728	54,739,791,579	2,913,072	35,050,078,856	19,689,712,722
Open Access Point	1,797,624	70,100,157,713	5,826,143	70,100,157,713	-

Table 13. Estimated Employment Impacts on a Reduction of Fishing Effort to Attain MSY and MEY, 1994

Sector	Maximum Sustainable Yield			Maximum Economic Yield		
	Percent Decrease in Effort	Current Number of Fishermen	Decrease in Employment	Percent Decrease in Effort	Current Number of Fishermen	Decrease in Employment
Commercial	12	319,937	38,392	45	319,937	143,972
Municipal	40	397,163	158,865	71	397,163	281,986
Sum			197,258			425,957
Overall Marine	35	717,100	250,185	65	717,100	466,115

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